Chlorine Gas:
Balancing Public Health and Security Webcast
Case Study- Conversion to Hypochlorite

Scott Dewhirst, P.E.
Chief of Facilities Engineering
Newport News Waterworks

Presentation Overview

- Background on Newport News Waterworks
- Drivers for our Conversion to Hypochlorite – Economic and Non-Economic Factors
- Issues with Hypochlorite Use
- Summary and Conclusions

Newport News Waterworks

- Over 400,000 customers
- Service area includes Cities of Newport News, Hampton, Poquoson and Counties of York and portions of James City
- Average daily demand ~ 45 MGD

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Newport News Waterworks

- Two water treatment plants
  - Harwood's Mill WTP (1989) – 48 MGD capacity
    - Liquid Chlorine Feed system using evaporators
    - Planned conversion to hypochlorite in next 3-5 years during planned plant upgrade project
  - Lee Hall WTP (2005) – 60 MGD capacity
    - Plant designed in late 1990's; construction began October 1999
    - On-site bulk storage sodium hypochlorite feed system

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Drivers for Our Conversion to Hypo

- Detailed Alternatives Analysis conducted during design
  - Evaluated several options:
    - Liquid chlorine (evaporators)
    - Gaseous chlorine (pressure/vacuum and all vacuum) – multiple cylinders connected
    - Bulk sodium hypochlorite
    - On-site generation of sodium hypochlorite
  - Developed listing of non-economic and economic factors

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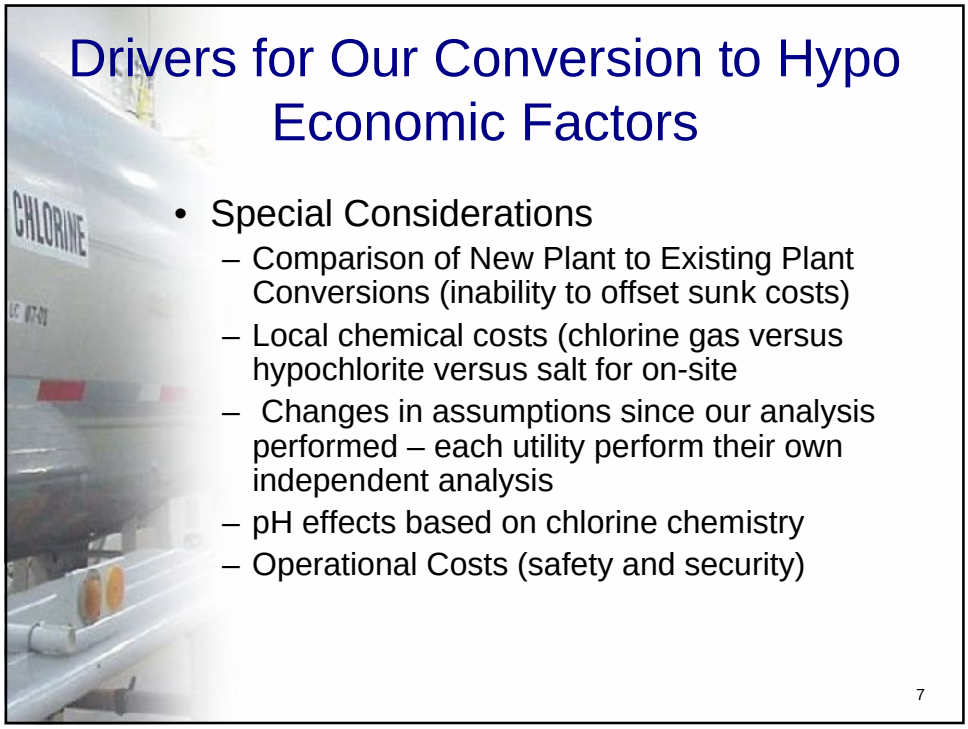

Drivers for Our Conversion to Hypo Economic Factors

- Special Considerations
  - Comparison of New Plant to Existing Plant Conversions (inability to offset sunk costs)
  - Local chemical costs (chlorine gas versus hypochlorite versus salt for on-site
  - Changes in assumptions since our analysis performed – each utility perform their own independent analysis
  - pH effects based on chlorine chemistry
  - Operational Costs (safety and security)

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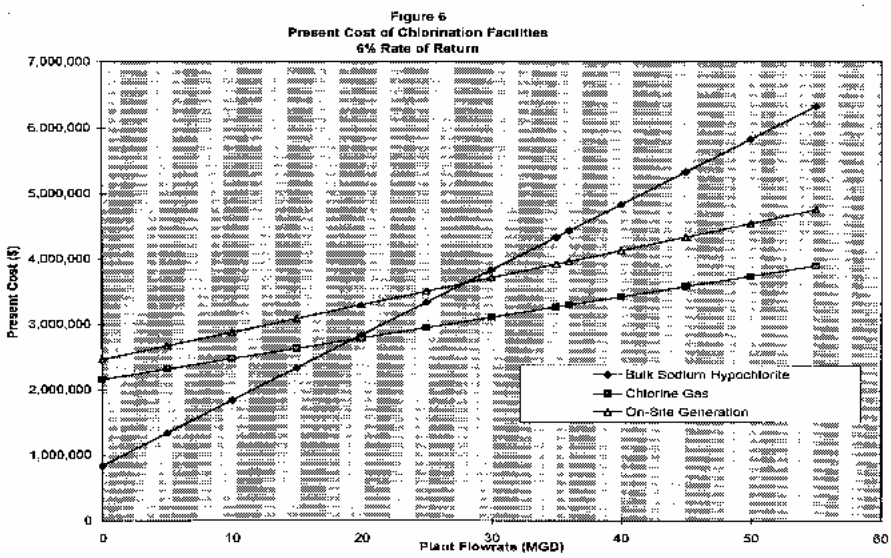
Drivers for Our Conversion to Hypo Economic Factors



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Drivers for Our Conversion to Hypo Economic Factors

- Breakpoint analysis showed:
  - Bulk hypochlorite most economical below 20 MGD
  - Break-even cost between bulk hypo and on-site generation at approximately 28 MGD
- Since study (1997) local gaseous chlorine costs have risen by ~ 100%; local hypochlorite costs risen by ~ 33% in same period
- Transportation Costs negligible during study
- "Neighborhood" Trends

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Drivers for Our Conversion to Hypo Non-Economic

- Key Non-economic Factors
  - Safety for Employees and General Public
  - Regulatory Requirements (Risk Management Plan)
  - Mitigation of Potential Accidents
  - Operational Issues
  - Security Requirements (Post 9/11 – DHS Chemical Facility Anti-Terrorism Standards)

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ALTERNATIVE	ADVANTAGES	DISADVANTAGES
Liquid Chlorine System	➢ Requires relatively few ton containers on-line to provide the design dosage. ➢ Comparable to the Harwood's Mill system	➢ System requires handling of liquid chlorine under pressure. ➢ System requires greater maintenance due to the need for evaporators ➢ Requires a Risk Management Plan per EPA and OSHA regulations
Chlorine Gas (Press/Vacuum)	➢ Eliminates the evaporators used in liquid chlorine	➢ Requires the use of a manifold cylinders and shutoff valves to restrict a leak to one ton container only. ➢ Requires a Risk Management Plan per EPA and OSHA regulations
Chlorine Gas (All-Vacuum)	➢ Offers the greatest safety in that all pressure piping is eliminated.	➢ Requires handling a number of vacuum regulators during a changeout of cylinders. ➢ Requires maintenance of many different gas filters. ➢ Requires a Risk Management Plan per EPA and OSHA regulations
Sodium Hypochlorite (Bulk Delivery and Storage)	➢ Uses conventional liquid chemical handling procedures.	➢ The 12.5% concentration of sodium hypochlorite degrades and can cause problems with valves and gas binding of pumps.
Sodium Hypochlorite (On-Site Generation)	➢ Safest alternative requires handling salt and 0.8% solution of sodium hypochlorite.	➢ The equipment necessary to generate the sodium hypochlorite makes this alternative have higher maintenance requirements.

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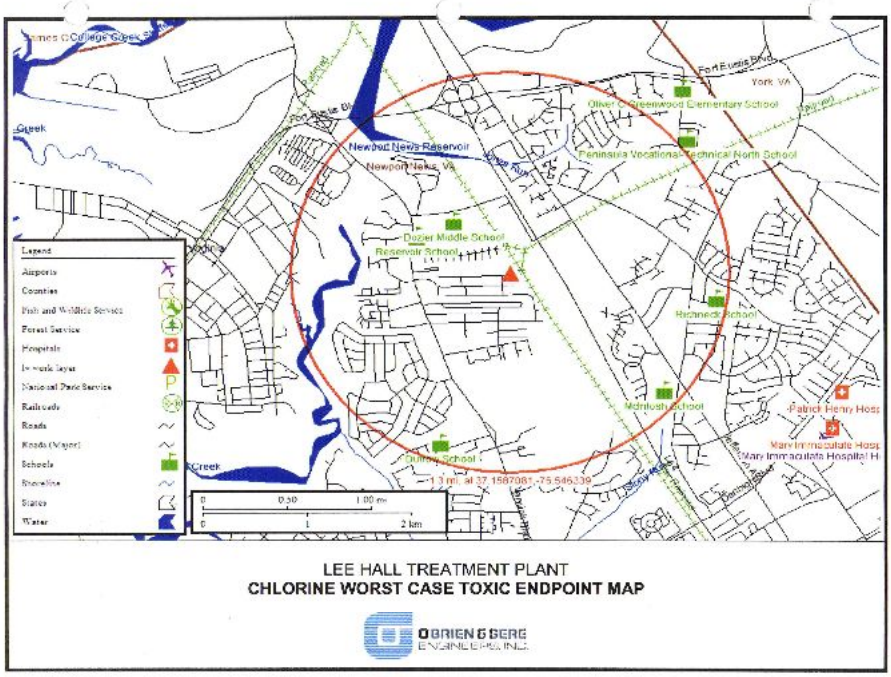

LEE HALL TREATMENT PLANT
CHLORINE WORST CASE TOXIC ENDPOINT MAP

O'BRIEN & GERE ENGINEERS, INC.

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Drivers for Our Conversion to Hypo

- Bottom line driver for our utility was safety of staff and neighbors
- Break-even costs were reasonable and manageable
- Logistics of implementation can be overcome
- Currently all neighboring utilities and commercial businesses using chlorine have or are in the process of converting to hypochlorite

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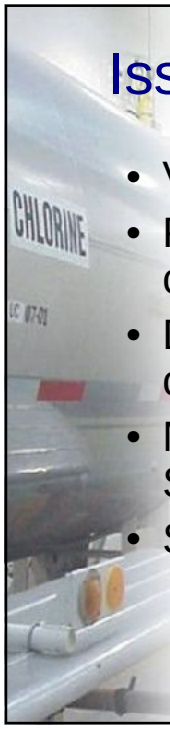
Issues with Hypochlorite Use



- Vent, vent, vent!!!
- Proper equipment selection, layout, construction orientation is critical
- Degradation of hypochlorite from original strength – storage requirements
- Materials of Construction of Bulk Storage Tanks and Gaskets
- Safety concerns

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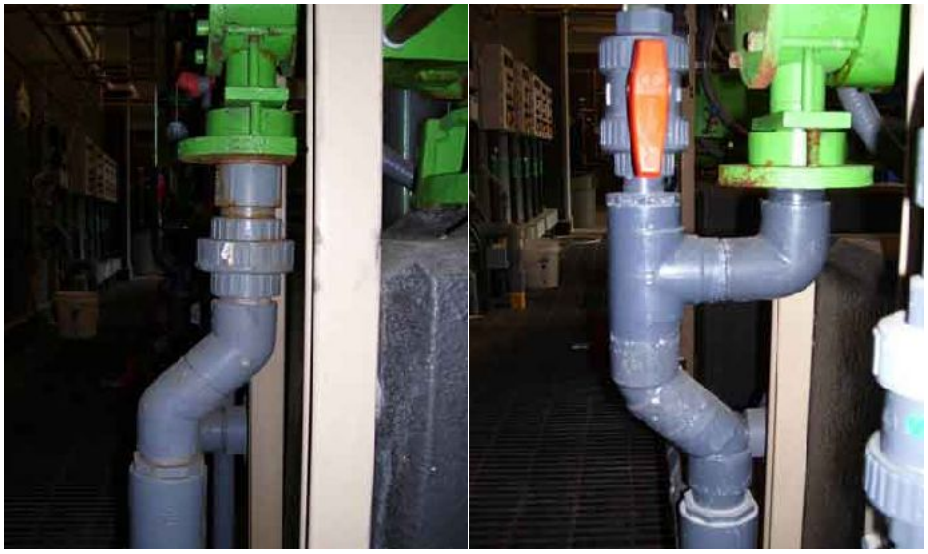
Issues with Hypochlorite Use



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Issues with Hypochlorite Use

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Issues with Hypochlorite Use

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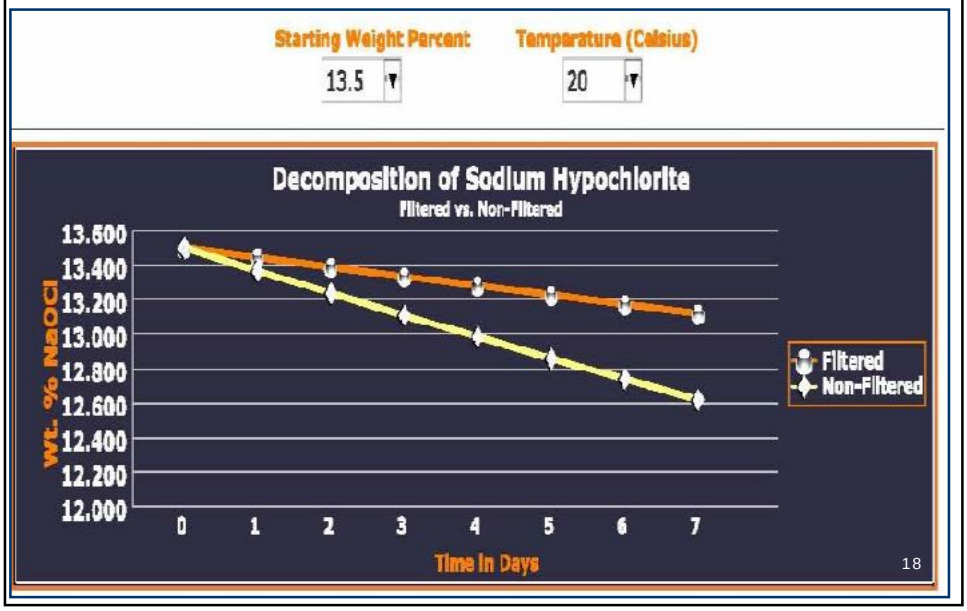
Issues with Hypochlorite Use



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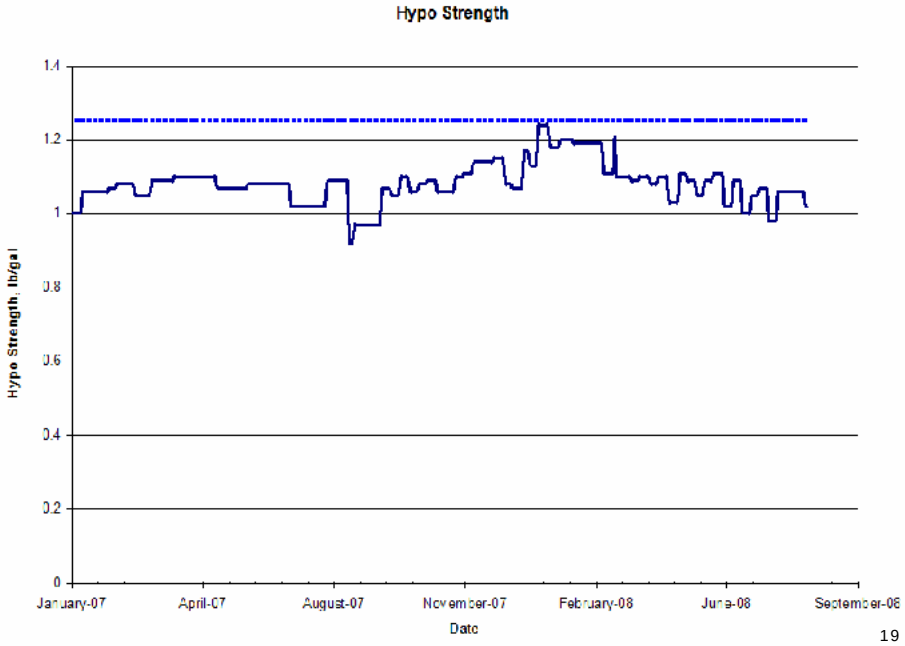

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Issues with Hypochlorite Use

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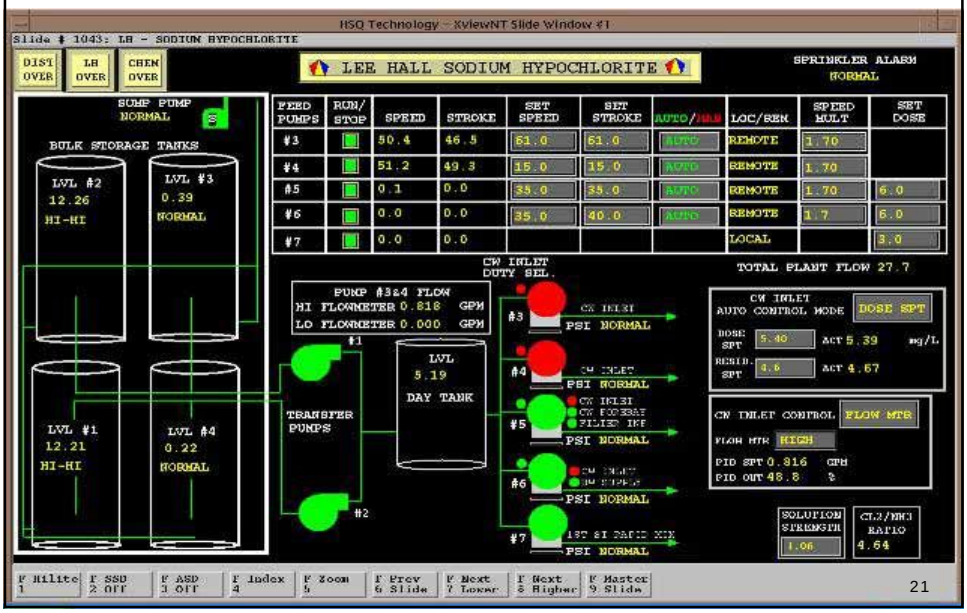
Issues with Hypochlorite Use



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Summary and Conclusions

- Each utility must develop their own listing of economic and non-economic factors and evaluate them systematically; include public input
- Hypochlorite is not without issues – handling, storage, feeding, etc.
- Local factors and regulatory requirements may drive the decision

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Ask the Experts


Bill Desing


Paul Kinshella


Scott Dewhirst


Bill Bellamy

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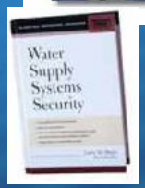

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- No. 64189, Chlorine Safety DVD
- No. 20568, Water Supply Systems Security
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